PATENT SPECIFICATION 734,446

Inventors:—HENRY ROMAINE WATSON and FREDERICK RALPH ELLIOTT.

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COMPLETE SPECIFICATION.

Operating the Flaps of Aircraft Wings.

We, SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LIMITED, a British Company, of Baginton, near Coventry, Warwickshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an aircraft wing having a low thickness/chord ratio such as is necessary if the aircraft is to fly at supersonic speeds, particularly at a Mach number of, say, two or higher.

In that case it is usually found necessary to provide the wing with a nose flap which can be lowered at low speeds—and, of course, there are usually ailerons or other flaps on the trailing edges.

The main object of the present invention is to arrange for the hinging of such a "thin" flap to be entirely internal—i.e., without any external excrescence. A further object is to provide a satisfactory actuating mechanism for turning such a flap which can be incorporated in the interior of the wing—e.g., along the joining edges of the wing and flap.

According to the invention, the adjacent edges of the wing and the flap have a number of coacting pairs of brackets which are provided with eyes to receive coaxial hinge pins and which are of a size not to exceed the thickness of the wing edge where they are secured, and some or all of the hinge pins have at least one set of two mutually-inclined splines on them, one of the splines of the set being slidingly received in a slot provided in the associated wing bracket and the other being slidingly received in a slot provided in the flap bracket; the arrangement being such that simultaneous axial movement of the splined hinge pins (as by a jack or other means along the line of the hinge pins) will turn the flap relatively to the wing.

In the accompanying drawings:—

Figure 1 is a diagrammatic plan of a single jack aligned with and controlling a number of hinge pins arranged according to the invention;

Figures 2 and 3 are sectional elevations of one of the hinge pins and its associated coacting pair of brackets at the edge of the wing and an adjacent flap, respectively, the sections being taken respectively on the lines 2—2 and 3—3 of Figure 4;

Figure 4 is a developed view mainly of the splines of the hinge pin when the flap is in one extreme position;

Figure 5 is a section view, to a slightly smaller scale, showing in full lines the flap when lowered to an extreme position, the other extreme position of the flap being indicated by chain lines; and

Figure 6 is a perspective view of the construction shown by Figure 5.

It may here be remarked that the construction of Figures 5 and 6 is a preferred construction, and differs slightly from that of Figures 2 to 4 as will be hereinafter pointed out; but in general the two constructions are substantially identical.

The flap 11 is shown in the drawings (see Figure 5 particularly) as a nose flap secured along the leading edge of an aircraft wing 12, though obviously the invention is equally applicable to a flap to be secured along the trailing edge of an aircraft wing. It is supported by a plurality of coacting pairs 14 of brackets, of which two pairs are seen in Figure 1.

Each wing bracket 16 comprises a pair of forwardly-extending arms 17 (Figure 6) with aligned eyes in them, the arms being spaced from one another axially to receive the associated bracket 18 of the flap. The eyes of all the brackets are coaxial.

It will be understood that any desired number of coacting pairs of brackets 14 may be axially disposed along the edge of

the wing. The brackets will normally decrease in size along the edge of the wing towards the wing tip dependently upon the wing thickness at any given spanwise station, the brackets being of a size not to exceed the wing thickness where they are secured to the edges of the wing and flap. The wing bracket 16 is recessed at 19 to receive the surface plating of the wing, as shown by Figure 5, and recesses 19*a* are provided in the flap bracket 18 to receive the surface plating of the flap.

Referring now to Figures 2 to 4 particularly, each hinge pin 20, carried in the eyes of a coacting pair of brackets, has a pair of diametrically-opposite straight splines 21 engaging in corresponding slots provided in the two arms of the wing bracket 16, and elsewhere a pair of diametrically-opposite inclined splines 22 engaged in slots provided in the flap bracket. Obviously, the necessary angular clearance will be provided for the inclined splines in the wing bracket, as indicated at 24, and for the straight splines in the flap bracket, as indicated at 25.

The main difference between the two constructions shown is that the extent of the angular clearance is used in Figures 2 to 4 to provide stops 27 to limit the turning movement of the flap, when the hinge pin of Figure 4 has been moved to the right, i.e., in the direction of the arrows 28. In Figures 5 and 6, however, use is made of a stop arm 30 on the flap bracket coacting in its extreme positions with abutments 31, 32. This construction is in general to be preferred to that of Figures 2 to 4 in which the straight and inclined splines are wedged into one of the brackets, as in that case some backlash may still be present between the splines and the other bracket. This possible disadvantage is entirely obviated by the use of the stop arm 30 and the associated abutments in the construction of Figures 5 and 6.

It is suggested that the inclination of the mutually-inclined splines 21, 22 should be such as to allow for a 30° turning movement of the flap for a three inch travel of the hinge pin. (Obviously, in the case of hinge pins of different diameters, the helix angles of the inclined splines 22 will be different). In such a case the mechanism will be irreversible—i.e., the flap can be actuated only by axial movements of the hinge pins and not by pressure on its surface.

In consequence, a simple hydraulic jack can be used without increasing the risk of flutter. Figure 1 indicates diagrammatically such a jack at 34 with its plunger 35 shown in the mid-position, in which the flap would occupy a position midway between that shown by the full lines in Figure 5 and that indicated by the chain lines in that figure.

In practice it is preferred that all the hinge pins 20 should be joined to one another and be operated by means of a single applying means, such as the jack 34, which, as shown by Figure 1, can easily be accommodated in the interior of the wing along the line of the hinge pins. Thus, the hinge pins can be constituted by a common rod which would conveniently be of reduced section between each actual hinge pin, i.e., between each pair 14 of coacting brackets. The drawings, however, show the actual hinge pins as being hollow ones secured upon shafts 37 which are adapted at their ends 38 to be joined to one another. In this way excessive friction on the hinges, such as might arise from bending of a common rod when the wing flexes under load, can be avoided.

By means of the invention the hinging of the flap and the actuating means therefor are entirely within the surface of the wing and flap. The hinge moment is applied at the maximum leverage allowable within the depth of the surface.

As the hinge pins are connected together so that the angular movement of each section of the flap relative to its adjacent portion of wing is the same, the flap is (substantially) free from torsional deflection along its length without reliance on its own torsional stiffness, which is limited in the case of a very thin flap.

What we claim is:—

1. An aircraft wing having a flap along one edge of the wing, in which the adjacent edges of the wing and flap have a number of coacting pairs of brackets which are provided with eyes to receive coaxial hinge pins and which are of a size not to exceed the thickness of the wing edge where they are secured, and in which some or all of the hinge pins have at least one set of two mutually-inclined splines on them, one of the splines of the set being slidingly received in a slot provided in the associated wing bracket and the other being slidingly received in a slot provided in the flap bracket; the arrangement being such that simultaneous axial movement of the splined hinge pins will turn the flap relatively to the wing.

2. A construction according to Claim 1, and for a nose flap, in which each wing bracket comprises a pair of forwardly-extending arms spaced from one another axially to receive the coacting bracket of the nose flap.

3. A construction according to Claim 1 or 2, in which the brackets decrease in size along the edge of the wing towards the wing tip dependently upon the wing thickness at any given spanwise station.

4. A construction according to any preceding claim, in which each splined hinge pin has a pair of diametrically-opposite straight splines engaged in corresponding slots in one of the associated brackets, and elsewhere a

pair of diametrically-opposite inclined splines engaged in slots provided in the other bracket.

5. A construction according to any preceding claim, in which a flap bracket is provided with a stop arm adapted to coact in its extreme positions with abutments provided in the interior of the wing.

6. A construction according to any preceding claim, in which the hinge pins are jointed to one another and operable by a single means disposed in the interior of the wing.

7. An aircraft wing having a nose flap which is hinged to the leading edge of the wing and adapted to be actuated substantially as hereinbefore described with reference to the accompanying drawings.

WALFORD & HARDMAN BROWN,
Chartered Patent Agents,
Roslyn Chambers, 47 Warwick Road,
Coventry, Warwickshire.

PROVISIONAL SPECIFICATION.

Operating the Flaps of Aircraft Wings.

We, SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LIMITED, a British Company, of Baginton, near Coventry, Warwickshire, do hereby decribe this invention to be described in the following statement:—

This invention relates to an aircraft wing having a low thickness/chord ratio such as is necessary if the aircraft is to fly at superconic speeds, particularly at a Mach number of, say, two or higher.

In that case it is usually found necessary to provide the wing with a nose flap which can be lowered at low speeds—and, of course, there are usually ailerons or other flaps on the trailing edges.

The main object of the present invention is to arrange for the hinging of such a "thin" flap to be entirely internal—i.e., without any external excrescence. A further object is to provide a satisfactory actuating mechanism for turning such a flap which can be incorporated in the interior of the wing—e.g., along the joining edges of the wing and flap.

According to the invention, the adjacent edges of the wing and the flap have a number of co-acting brackets providing eyes which receive hinge pins, and, some or all of the hinge pins have at least one set of two mutually inclined splines on them, one of the splines being received in a slot provided in a wing bracket and the other being received in a slot provided in a flap bracket, the arrangement being such that simultaneous axial movement of the hinge pins (as by a jack or other means along the line of the hinge pins) will turn the flap relatively to the wing.

In one construction according to the invention, as applied to a nose flap, each wing bracket comprises a pair of forwardly-extending ears with aligned eyes in them, the ears being spaced from one another axially to receive the associated bracket of the nose flap. Any desired number of sets of such brackets may be axially spaced along the wing edge. They will normally decrease in diameter along the edge to the wing tip dependently upon the wing thickness at any given spanwise length.

Preferably, each hinge pin has a pair of diametrically opposite straight splines engaged in corresponding slots provided in the two ears of the wing bracket, and elsewhere a pair of diametrically opposite inclined splines engaged in slots provided in the flap bracket. Obviously, the necessary angular clearance will be provided for the inclined splines in the wing brackets, and for the straight splines in the flap brackets; and the extent of this angular clearance may be used to provide stops to limit the turning movement of the flap in both directions.

As an obvious alternative, however, the converse arrangement could be used.

It is suggested that the inclination of the mutually-inclined splines should be such as to allow for a 30° turning movement of the flap for a 3″ travel of a hinge pin. In such a case the mechanism will be irreversible—i.e., the flap can be actuated only by the axial motion of the hinge and not by pressure on its surface—and a simple hydraulic jack can therefore be used without increasing the risk of flutter.

In practice, it is preferred that all the hinge pins should be joined to one another and be operated by means of a single jack, which can easily be accommodated in the interior of the wing along the line of the hinge pins. Thus, the hinge pins can be constituted by a common rod which would conveniently be of a reduced section between each actual hinge pin—i.e., between each set of coacting brackets. Preferably, however, the hinge pins are hollow ones which are jointed to shaft portions at their ends in order to avoid excessive friction at the hinges due to bending of a common rod as the wing flexes under load. Alternatively, however, the hinge pins may be connected to a common "push-pull" rod for movement in unison.

By means of the invention the hinging of the flap and the actuating means therefore are entirely within the surface of the wing

and flap. The hinge moment is applied at the maximum leverage allowable within the depth of the surface. By connecting the hinge pins together to a common "push-pull" rod, or other fabricated rod, so that all the pins rotate through the same angle, the torsional stiffness of the flap is replaced or augmented.

WALFORD & HARDMAN BROWN,
Chartered Patent Agents,
Roslyn Chambers, 47 Warwick Road,
Coventry, Warwickshire.

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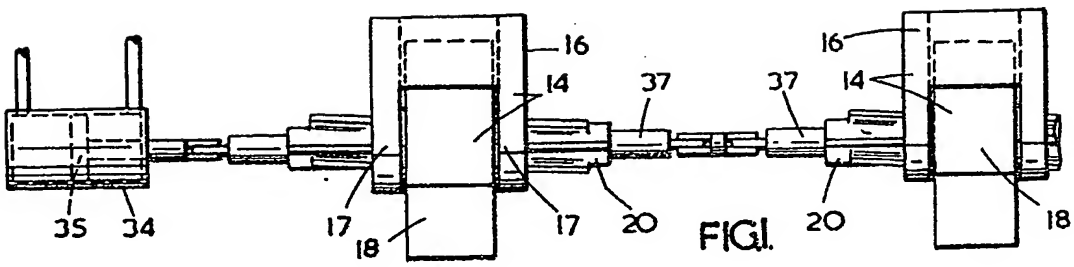


FIG1.

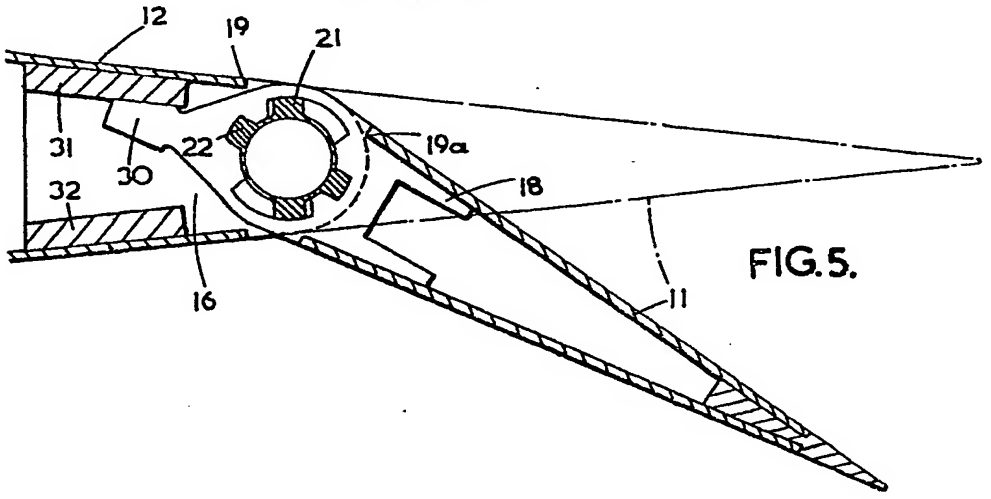


FIG.5.

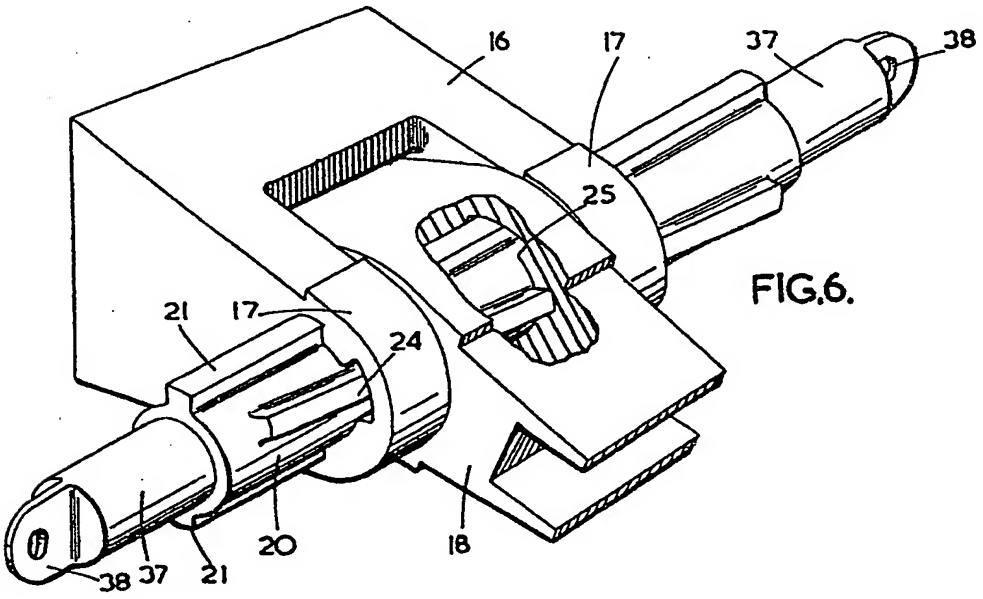
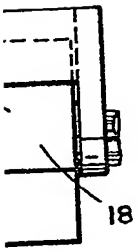


FIG.6.

734,446 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

SHEETS 1 & 2



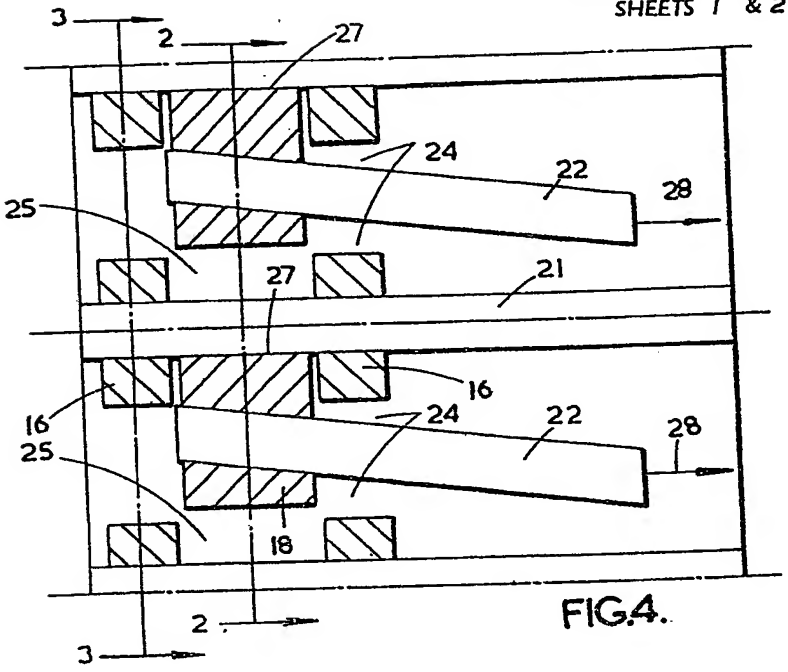


FIG.4.

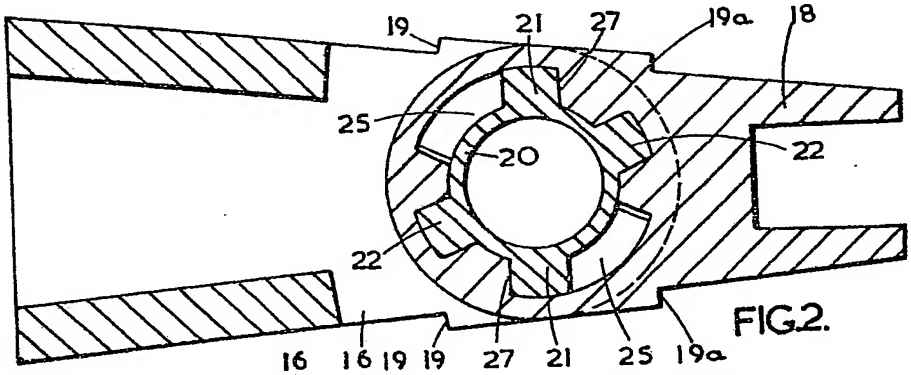


FIG.2.

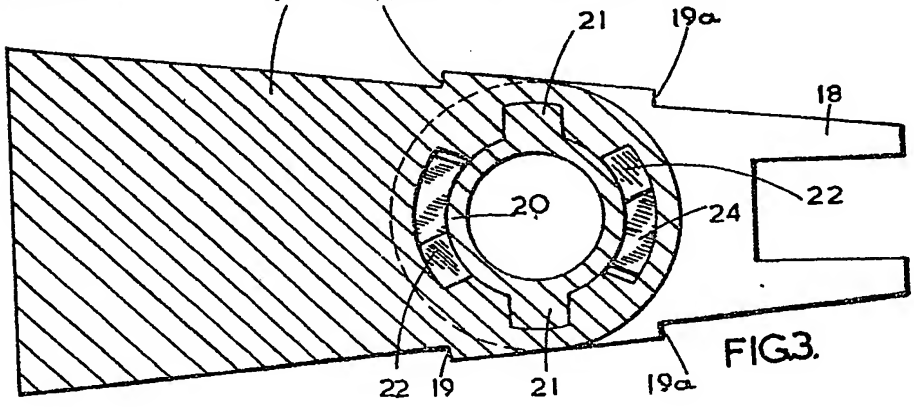


FIG.3.

734,446 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

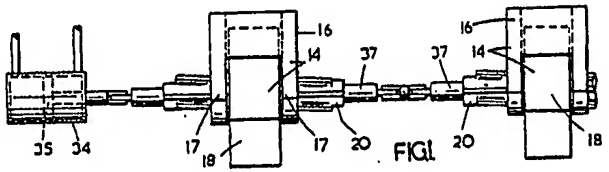


FIG.1.

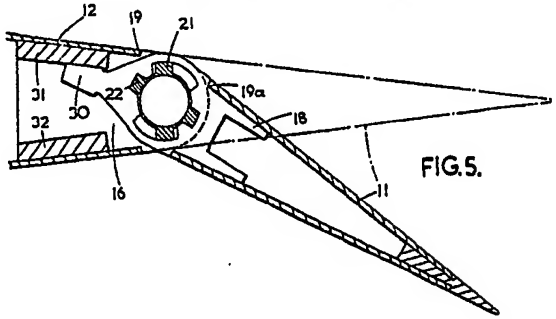


FIG.5.

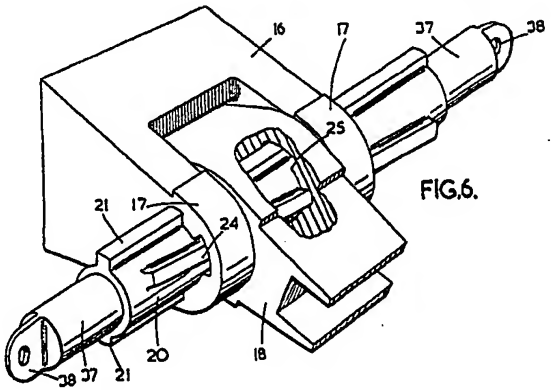


FIG.6.

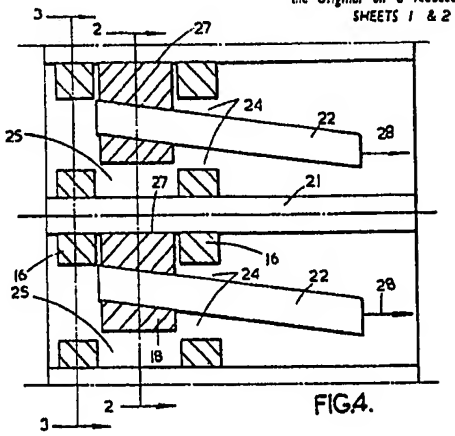


FIG.4.

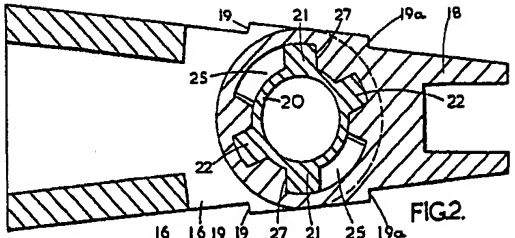


FIG.2.

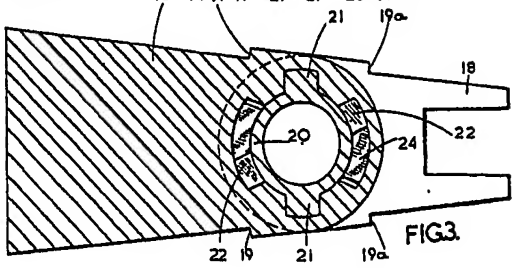


FIG.3.